

ILLEGIB

~~TOP SECRET~~

NPIC/R-901/64
October 1964

DECLASS REVIEW BY NIMA / DoD

15052

17 Pages

Copy 4

PHOTOGRAPHIC INTERPRETATION REPORT

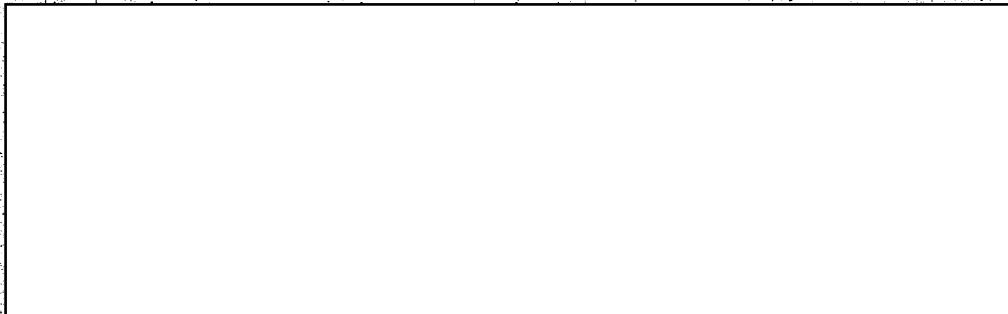
UNUSUALLY CONFIGURED ANTENNAS AT FACILITIES NEAR TALDOM AND NIKOLAYEV, USSR



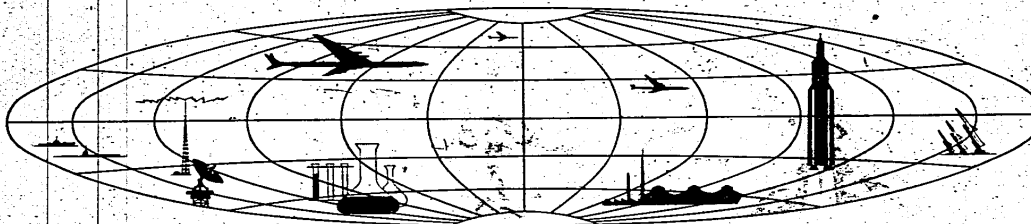
CIA



DIA



NATIONAL PHOTOGRAPHIC INTERPRETATION CENTER



~~TOP SECRET~~

GROUP 1
Excluded from automatic
downgrading and declassification

TOP SECRET

PHOTOGRAPHIC INTERPRETATION REPORT

UNUSUALLY CONFIGURED ANTENNAS
AT FACILITIES NEAR TALDOM AND
NIKOLAYEV, USSR

NPIC/R-901/64

October 1964

NATIONAL PHOTOGRAPHIC INTERPRETATION CENTER

TOP SECRET

INTRODUCTION

25X1D An examination of photography of [redacted] located
25X1D [redacted] six antennas of an unusual configuration at broad-
cast/communications facilities near Taldom
and Nikolayev (Figure 1). This report contains
a general description of each facility. [redacted]

nents is shown graphically on the appropriate figure for each facility; dimensions have been collected in Table 1, for purposes of comparison.

Age of Facilities and Antennas

Although only recently noted, the antennas are not new, their detection at this time being largely a result of the steadily improving quality of KH-4 photography

The layout of each antenna's compo-

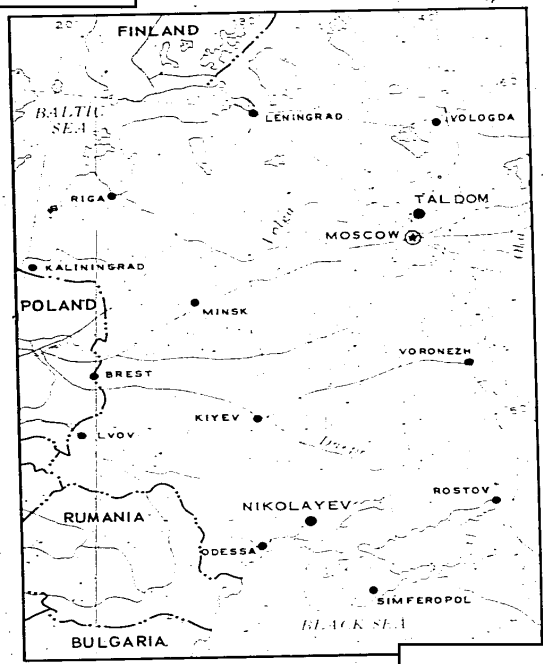


FIGURE 1. LOCATION MAP.

[redacted] There is no coverage available to establish negation dates or chronologies of previous construction progress; recent photography [redacted] has revealed a number of double rhombic antennas under construction at the Nikolayev facility.

- 1 -

25X1B

TOP SECRET

--

TOP SECRET

25X1B

NPIC/R-901/64

TALDOM BROADCAST/COMMUNICATIONS FACILITY

25X1A The Taldom broadcast/communications facility is situated at 56-44-25N 37-36-00E, an area of slight relief 2.3 nautical miles (nm) east-northeast of the center of the town of Taldom (Figure 2). The approximate elevation of the facility is 475 feet, with reasonably heavy vegetation covering a major portion of its fenced area (Figure 3). Elec-

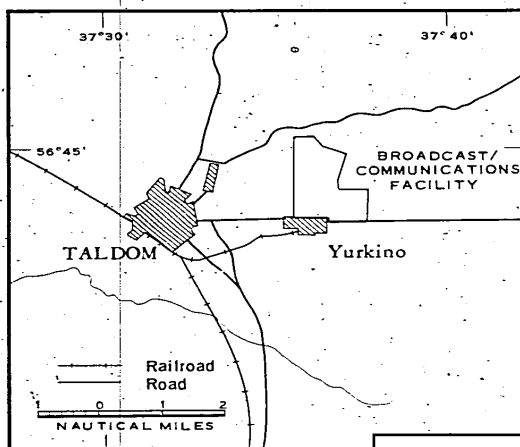


FIGURE 2. LOCATION OF TALDOM FACILITY.

tronic components in the operations area of the facility (Figure 4) include 4 of the previously mentioned antennas of unusual configuration, 11 HF rhombic antennas, 2 antenna reflectors with probable feed towers, a probable vertical radiator antenna tower with a probable ground system, and at least 6 other unidentified towers.

The four unusually configured antennas are discussed in detail in a separate section of this report, below; their dimensions are given in Table 1:

The 11 rhombic antennas are grouped in the southeastern portion of the facility, 8 of them arranged as 4 day-night pairs. The azimuths given for these antennas are only rough approximations.

The two antenna reflectors (Figure 5) are situated in the southeastern extension of the facility and are positioned side by side about 125 feet apart. Both have a 55-foot-wide rectangular shape and are tower mounted, placing the top of the reflector about 145 feet above

TOP SECRET

TOP SECRET

NPIC/R-901/64



FIGURE 3. TALDOM BROADCAST/COMMUNICATIONS FACILITY.

- 3 -

TOP SECRET



FIGURE 4. LAYOUT OF TALDOM BROADCAST/COMMUNICATIONS FACILITY.

--

TOP SECRET

NPIC/R-901/64

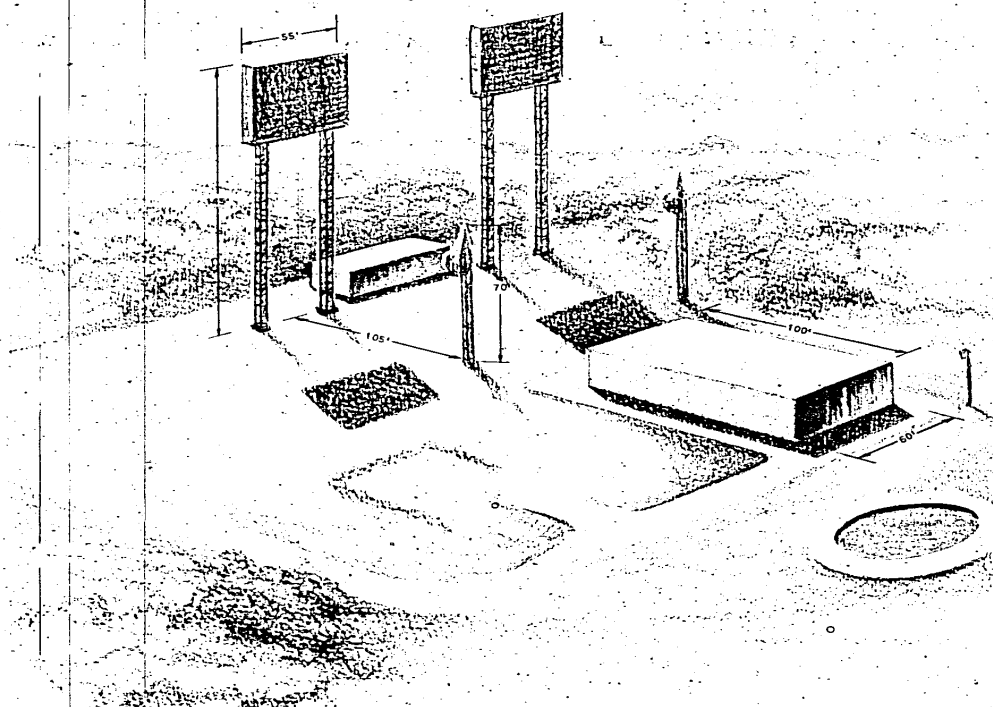


FIGURE 5. PERSPECTIVE VIEW OF TOWER-MOUNTED REFLECTORS AT TALDOM.

ground level. One hundred and five feet north of the eastern antenna reflector is a 70-foot-high probable feed tower; in all likelihood a similar tower is situated in front of the western reflector, but ground shadows preclude its observation. Centered just north of the probable feed towers is a small control building with an adjacent cooling pond/tank.

Other standard-type control buildings, in

addition to the one just mentioned, include at least one other small and three larger ones, the latter all having adjacent cooling ponds/tanks. There are also five of the probable control buildings of unique appearance which have been described previously.

A small support area is situated in the extreme southern part of the facility, adjacent to the village of Yurkino.

TOP SECRET

TOP SECRET

NPIC/R-901/64

NIKOLAYEV BROADCAST/COMMUNICATIONS FACILITY

25X1A

The Nikolayev broadcast/communications facility is situated 12.5 nm southeast of the center of Nikolayev at 46-49-20N 32-12-50E (Figure 6) on virtually flat terrain at an elevation of approximately 150 feet. The facility (Figures 7 and 8) consists of separately fenced operations and support areas, with a number of rhombic antennas under construction to the south and west of the operations area fence.

The operations area includes two of the unusually configured antennas, one large and one small, which appear virtually identical in design to those at Taldom. However, the larger antenna has two fixed self-supporting feed towers, and the smaller antenna has its single feed tower mounted on a two-rail track which is somewhat wider than--although otherwise similar to--the three comparable tracks at

Taldom. Other antennas within the operations area include two curtain arrays (one 3-bay and one 2-bay), and a probable vertical radiator. Under construction outside the fence are 10 double rhombic antennas, 8 of which are arranged as 4 day-night pairs. The azimuths shown for these antennas on Figure 8 are only approximate. Control buildings in the area include 3 of the standard HF type, each having 2 adjacent cooling ponds/tanks, and 2 of the previously described probable control buildings of unique appearance, one associated with each unusually configured antenna. In the northwestern corner of the area is a large reservoir with several adjacent support buildings, and a few other support/control buildings are found throughout the area.

The support area, adjoining the northern limit of the operations area, contains over 20 barracks-type, administration, and general-purpose buildings.

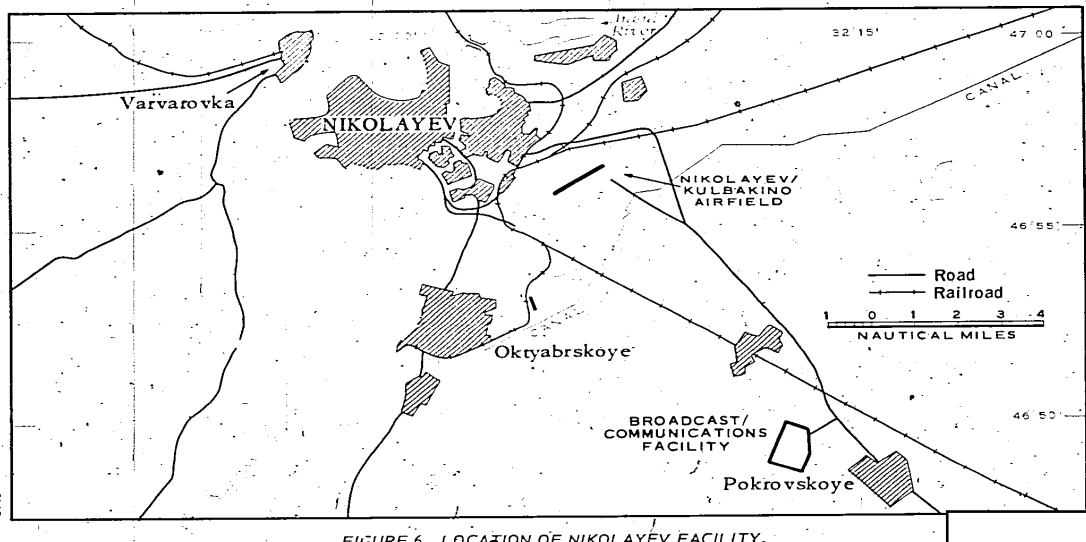


FIGURE 6. LOCATION OF NIKOLAYEV FACILITY.

TOP SECRET

TOP SECRET

NPIC/R-901/64

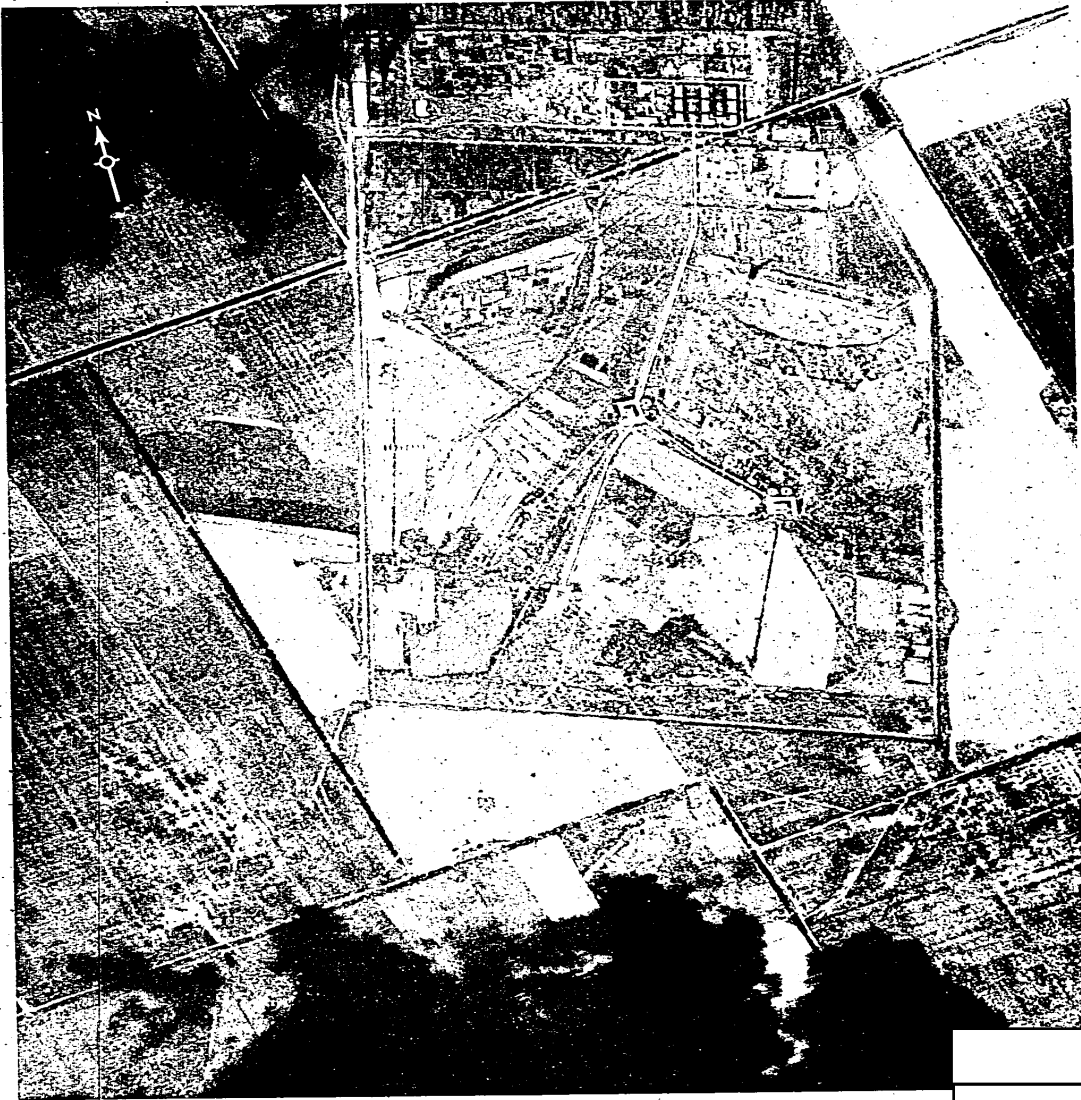


FIGURE 7. NIKOLAYEV BROADCAST COMMUNICATIONS FACILITY.

- 7 -

TOP SECRET

TOP SECRET

NPIC/R-901/64

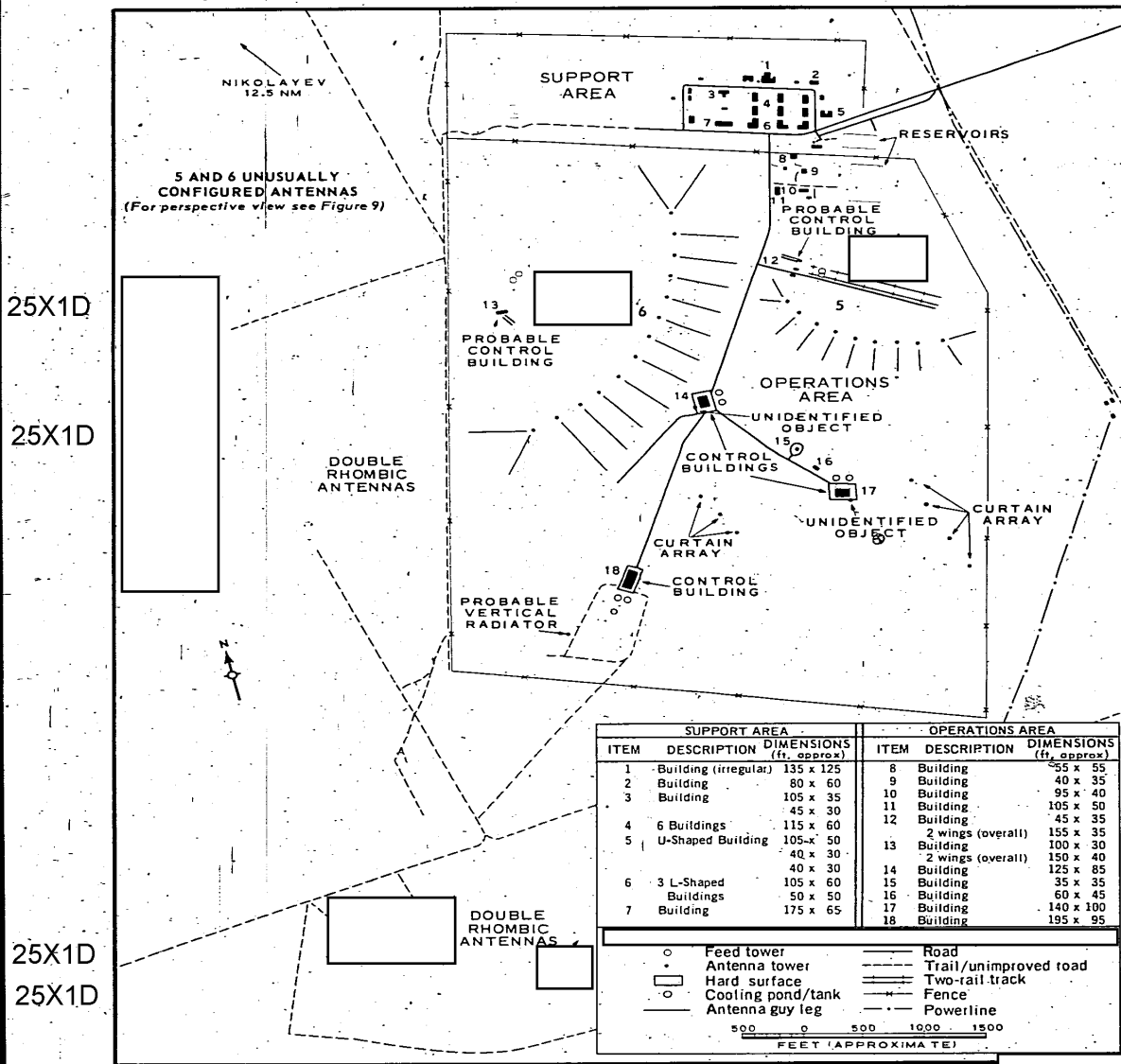


FIGURE 8. LAYOUT OF NIKOLAYEV BROADCAST/COMMUNICATIONS FACILITY.

TOP SECRET

TOP SECRET

NPIC/R-901/64

UNUSUALLY CONFIGURED ANTENNAS

General Description

Basically, the antennas consist of either 9 or 13 guyed towers arranged in a slight arc that faces a self-supporting feed tower which is either fixed or mounted on a low gantry-like structure on a two-rail track laid out parallel to a line drawn between the end towers of the arc (the longest chord). These general characteristics are shown in the perspective view of Figure 9, and can be summarized as follows:

Antenna Number (keyed to Figures 4 and 8)	Location of Antenna	Number of Towers in Arc	Mounting of Feed Tower
1	Taldom	9	Track
2	Taldom	13	Track *
3	Taldom	9	Track
4	Taldom	9	Fixed
5	Nikolayev	9	Track
6	Nikolayev	13	Fixed **

*Possibly two towers

**Two towers

Specific mensural data for each of the six antennas has been brought together in Table 1 for comparative purposes.

Design Considerations

In order to enhance the maximum detection potential of the photography, a wide variety of possible antenna reflectors and illuminators was considered, among which were spherical, circular, torus, and parabolic torus, 1/ as well as many designs incorporating various combinations of reflectors and illuminators, such as wire-grid lens antennas, 2/ reflectarray antennas, 3/ and Dolph-Chebyshev arrays. 4/ Unfortunately, the intricate details utilized in these systems proved to be wholly beyond the detection potential of available photography, and only general conclusions could be reached.

25X1B.

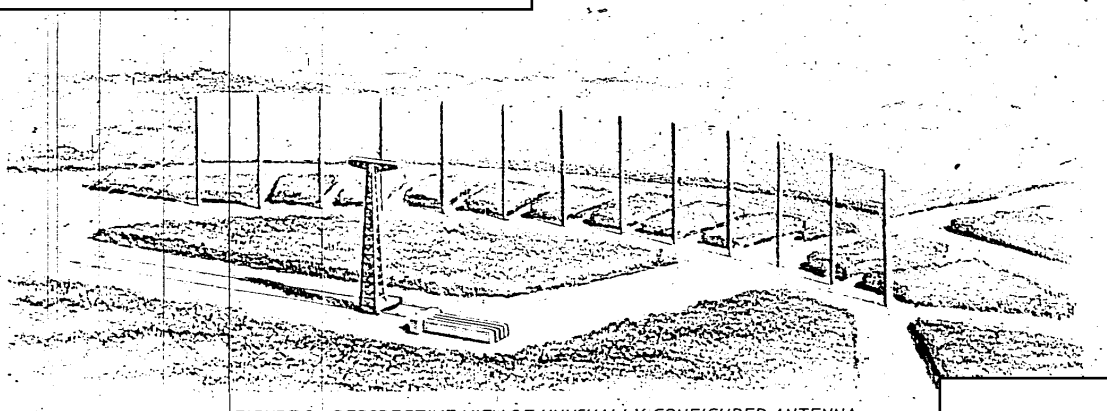


FIGURE 9. PERSPECTIVE VIEW OF UNUSUALLY CONFIGURED ANTENNA.

TOP SECRET

TOP SECRET

25X1B

NPIC/R-901/64

25X1A

25X1A

The difficulties with movable large-aperture reflectors arise not only from the staggering construction costs, but more importantly from mechanical deformations which impose limitations on wavelength, and indirectly on gain and resolution. However, the problems encountered with large movable reflectors could possibly be overcome through the use of large stationary reflectors which could be steered electronically or by spatially movable feeds.

Location of Feed Source (Illuminator)

In generally accepted engineering practice, circular or parabolic reflectors can be illuminated by a single source rotating about the focal point, by multiple sources placed along the focal axis, $5/$ or by a spatially movable source traveling along the focal arc (Figure 10). At the

25X1B

This statement appears paradoxical in view of the presence of rail-mounted and movable towers (definite evidence, of which is offered by earlier photography of Nikolayev $5/$ where the feed tower is observed at a different location along the track), yet the fact remains that, whether the reflector is circular or parabolic, the rails extend in the wrong direction. From this circumstance, together with the fact that two of the antennas apparently have no spatially movable elements at all, it appears evident that if steering is indeed accomplished, then it must be from a feed source at the focal point, and the reason for mounting the feed towers on rails remains undetermined.

Geometry of the Reflector

Attempts to determine whether the arc of

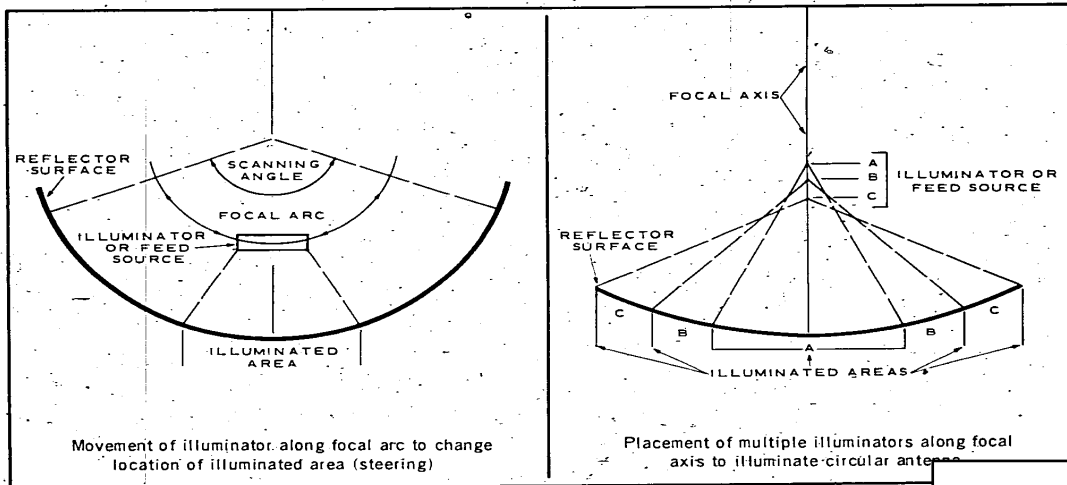


FIGURE 10. TWO METHODS OF ILLUMINATING LARGE-APERTURE REFLECTORS.

TOP SECRET

TOP SECRET

NPIC/R-901/64
25X1D

25X1D

25X1D

Table 1. Comparative Mensural Data on Unusually Configured Antennas

Antenna Number (keyed to Figures 4 & 6)	Location of Antenna	Towers in Arc					Track		Feed Tower	
		Number of Towers	Separation (feet, average)	Height (feet)	Longest Chord (feet)	Center Tower to Feed Tower or Nearest Rail (feet)*	Rail Separation (feet)	Length (feet)	Height (feet, approx)	Base (feet)
1	Taldom	9		330	1,475	535	80	1,075	250	85 x 25
2	Taldom	13		600	2,950	1,205	80	1,465	335	85 x 25
3	Taldom	9		395	1,470	510	80	870		85 x 25
4	Taldom	9		330	1,485		No track present		220	--
5	Nikolayev	9		320	1,435	625	140	1,445	240	140 x 50
6	Nikolayev	13		650	2,965	1,500	No track present		485	--

*Distance between end towers

**Measured along the perpendicular bisector of the longest chord

antennas formed a section of a circle or of a parabola utilized both mathematical and graphical analysis, with neither approach giving conclusive results.

Mathematically, the preparation of an equation-solving program for computer solution was hampered by the impossibility of providing sufficiently precise coordinates for the individual towers because of photographic rectification limitations and other physical difficulties.

On the other hand, a purely graphical solution developed an equally convincing case for both a parabolic reflector with its feed source at the focal point and for a circular reflector with its feed source at approximately one-half the radius (Figure 11).

When transposed to the photography, this theoretically developed feed source location was found either to be collocated with a fixed tower, or to fall at a point between the rails in the case of a movable tower. In either case, the conditions for satisfactory propagation were met since, from an engineering point of view, the performance of a circular section reflector approximates that of a parabolic section, provided that the radius of the illuminated area does not exceed a certain fraction of the focal length. 6/

Probable Correspondents

The propagation azimuths of the unusually

configured antennas as given in this report are derived from geometric analysis, and based on the belief that the antennas are probably transmitting and are fed at or near their parabolic focal point or, if circular, at a distance from the center tower of slightly less than one-half the radius, the radio energy then being reflected off the arc of towers. The great-circle projections of these orientations, [redacted]

[redacted] are shown on Figure 12, the numbering of each antenna corresponding to that of Figures 4 and 8.

It will be noted that the propagation azimuths of antennas 1 (Taldom) and 5 (Nikolayev) intersect at Petropavlovsk, while that of antenna 3 (Taldom) passes through Vladivostok, both cities being very active strategic locations in the Far Eastern area of the USSR. Also noteworthy is the concentration of propagation azimuth projections in the eastern US and Central America, and the fact that antenna 4 (Taldom) passes through Havana, Cuba, which has international communications facilities, some of which could correspond with areas near Taldom and Nikolayev. 7/

(The azimuths given for the rhombic antennas on Figures 4 and 8 are only approximate and are not adequate for plotting.)

TOP SECRET

25X1

TOP SECRET

NPIC/R-901/64

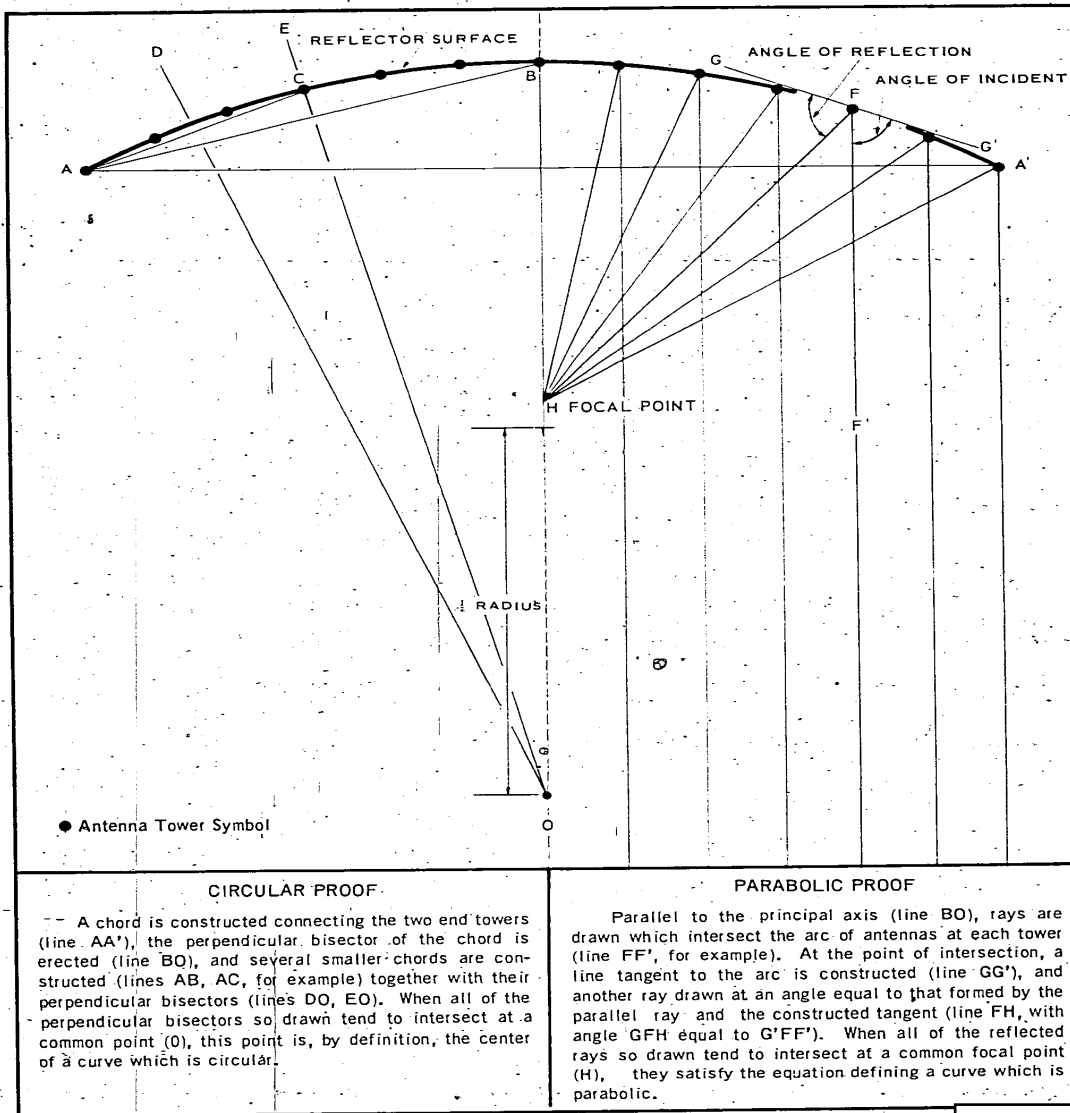


FIGURE 11. GEOMETRIC ANALYSIS OF REFLECTOR CONFIGURATION.

TOP SECRET

TOP SECRET

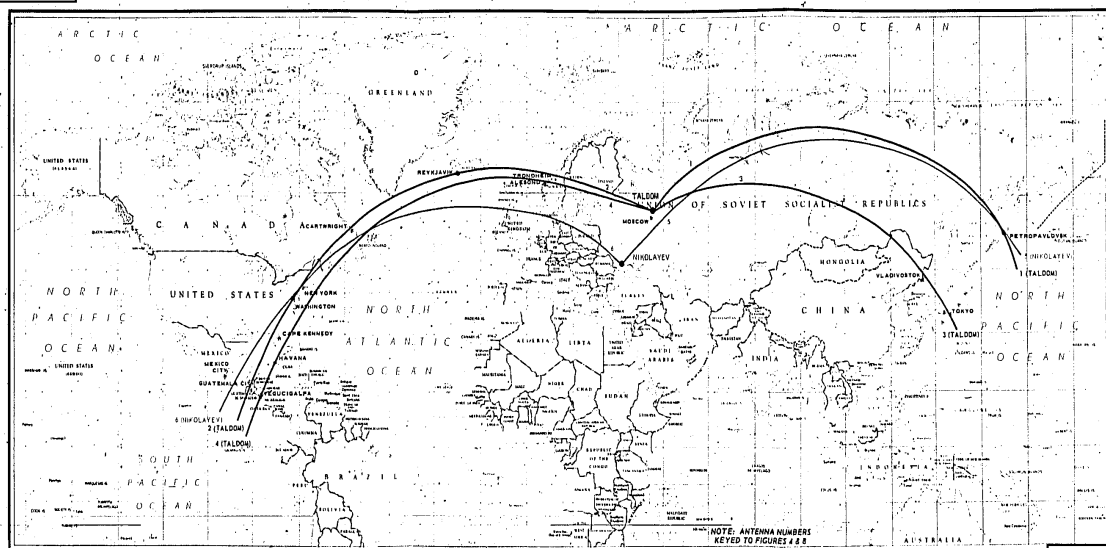


FIGURE 12. GRAY-CIRCLE PROJECTION OF ANTENNA PROPAGATION AZIMUTHS.

TOP SECRET

TOP SECRET

NPIC/R-901/64

REFERENCES

PHOTOGRAPHY

25X1D

MAPS OR CHARTS

1. DIA. US Air Target Chart, Series 200, Sheet 0250-9HL, 3d ed, Apr 63, scale 1:200,000 (SECRET)
2. DIA. US Air Target Chart, Series 200, Sheet 0154-23HL, 2d ed, Apr 63, scale 1:200,000 (SECRET)

DOCUMENTS

1. Jasik, H. *Antenna Engineering Handbook*. New York, McGraw-Hill, 1961 (U)
2. Tanner, R.L. and Andreassen, M.G. *A Wire-Grid Lens Antenna of Wide Application*. Transactions on Antennas and Propagation, Institute of Electrical and Electronic Engineers, Vol AP 10 (pp 408-429), Jul 62 (U)
3. Berry, D.G. and Malech, R.G. *The Reflectarray Antenna*. Transactions on Antennas and Propagation, Institute of Electrical and Electronic Engineers, Vol AP 11 (pp 645-651), Jul 63 (U)
4. Barnett, R.I. and Tai, C.T. *The Effect of Conducting Half-plane Sheet on the Radiation Patterns of Dolph-Chebyshev Arrays*. Transactions on Antennas and Propagation, Institute of Electrical and Electronic Engineers, Vol AP 12 (pp 455-458), Jul 64 (U)
5. Schell, A.C. *The Diffraction Theory of Large Aperture Spherical Reflector Antennas*. Transactions on Antennas and Propagation, Institute of Electrical and Electronic Engineers, Vol AP 11 (pp 428-432), Jul 63 (U)
6. Searing, R.M. *An Analysis of Stationary Hemispherical Reflectors Used as Narrow Beam, Wide-Angle Scanning Antennas*. Sunnyvale, Calif., Lockheed Missiles and Space Company, 1959 (U)
7. NPIC. R-1519 '63, *Cuban International Communication Broadcast Stations*, Oct 63 (SECRET)

REQUIREMENTS

CIA. C-SI4-S1.712

NPIC PROJECT

N-855/64

- 15 -

TOP SECRET